



Midwest Research Institute

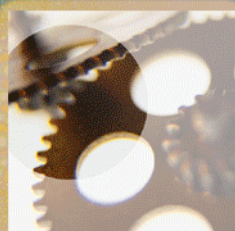
solutions through science and technology



growth



innovation



excellence



recognition

Safety of U-turns at Unsignalized Median Openings

Ingrid Potts

Midwest Research Institute

Kansas City, MO

August 31, 2004



Co-Authors

- Douglas W. Harwood
 - Midwest Research Institute
- Herbert S. Levinson
 - Transportation Consultant
- Jerry Gluck
 - Urbitran Associates, Inc.



Background

- Installation of nontraversable medians
 - Improve safety and travel times
 - Access management
- Introduction of median openings for U-turns
- Indirect left turns
 - Left turns prohibited at intersections
 - Florida, Michigan, and New Jersey



Midwest Research Institute
solutions through science and technology

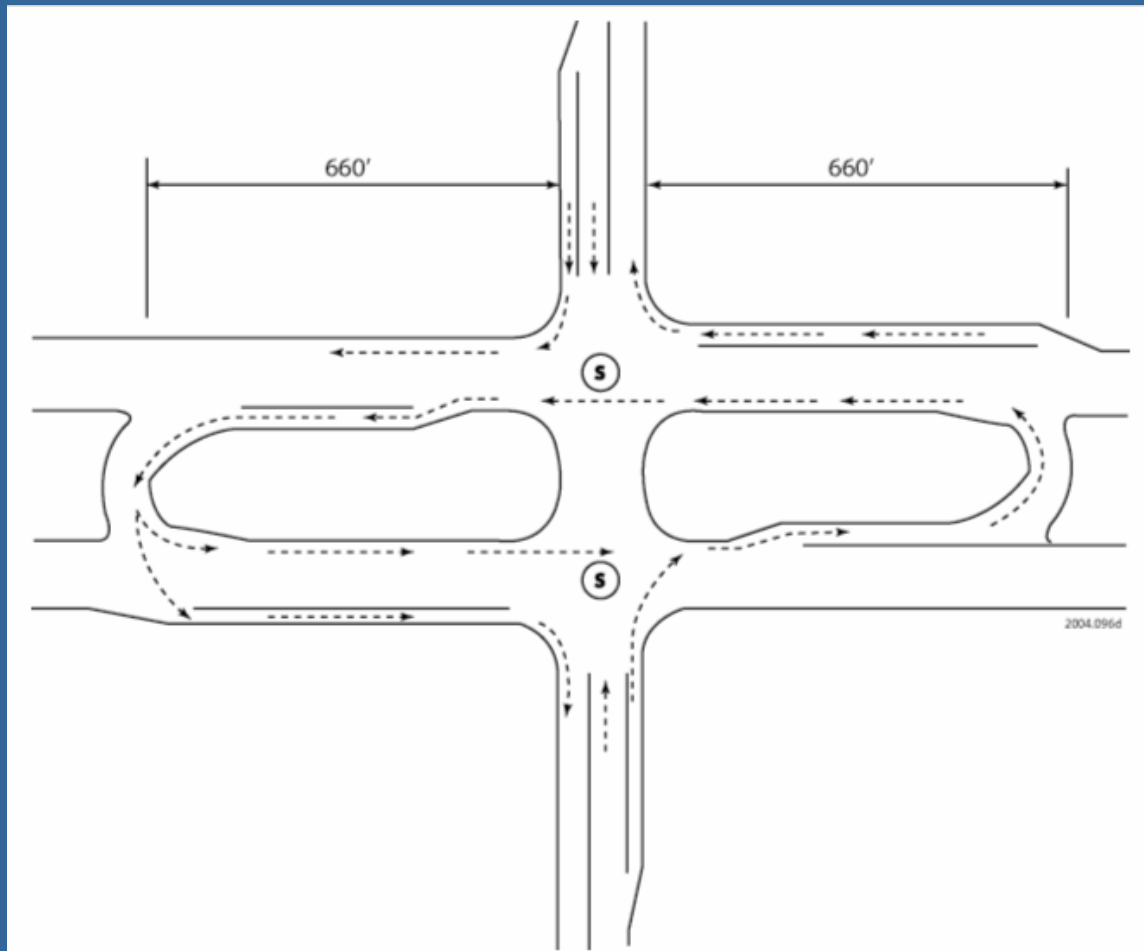
Unsignalized Median Opening





Midwest Research Institute
solutions through science and technology

Indirect Left Turn





Background

- Increase in U-turns at nearby median openings
- What is the effect on safety?
- NCHRP Project 17-21, “Safety of U-Turns at Unsignalized Median Openings”
 - Document the safety performance of median openings
 - Determine the safety and operational impact of U-turns
 - Develop a guide for the use, location, and design of unsignalized median openings for U-turns



Outline

- Highway agency survey
- Classification of typical median opening designs
- Data collection and analysis
- Key findings
- Applications for access management



Midwest Research Institute

solutions through science and technology

Survey of Highway Agency Practice



Survey of Highway Agency Practice

- Survey questionnaire sent to:
 - 50 states (35 respondents)
 - 94 cities (23)
 - 15 counties (7)
- Ten respondents have a formal policy for U-turn maneuvers
- Most rely on *AASHTO Green Book*



Survey of Highway Agency Practice

- U-turns permitted:
 - Locations having sufficient roadway width for maneuver
 - Where a specific need is identified
- U-turns prohibited:
 - Safety problems
 - School zones
 - To relieve congestion



Midwest Research Institute

solutions through science and technology

Classification of Median Openings



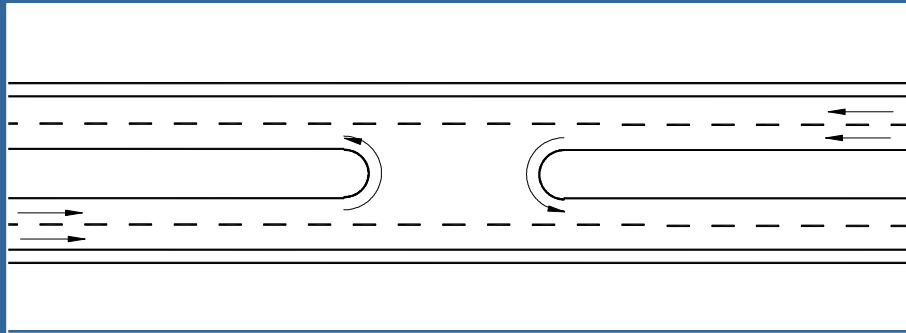
Classification of Median Openings

- Type of geometry
- Degree of access served
- Presence of left-turn lanes
- Presence of loons

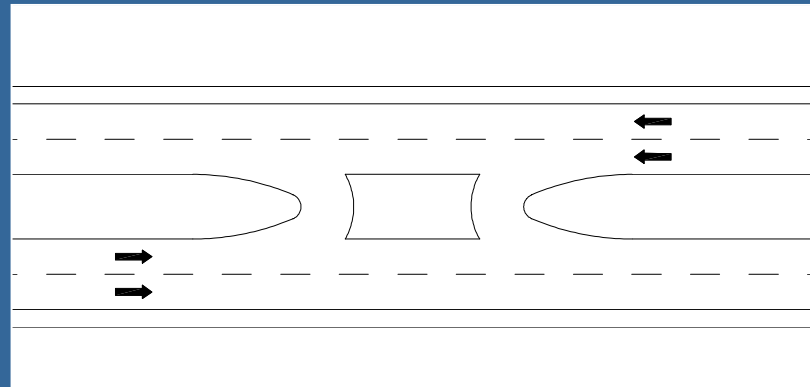


Classification of Median Openings

- Type of geometry
 - Conventional



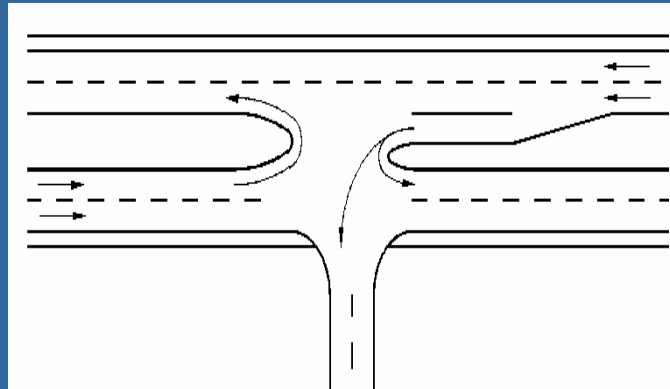
- Directional



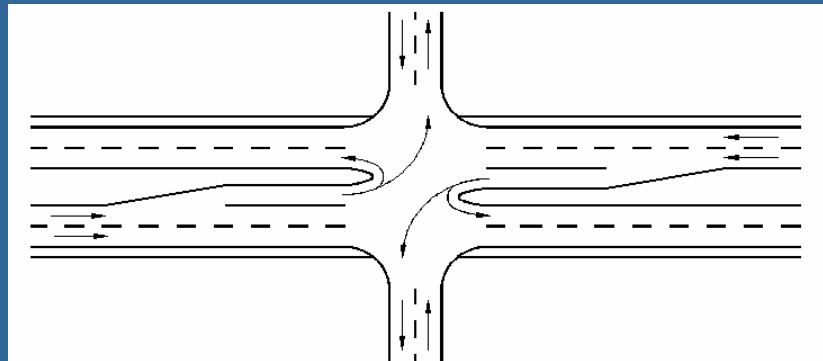


Classification of Median Openings

- Degree of access served
 - Midblock
 - Three-leg intersection



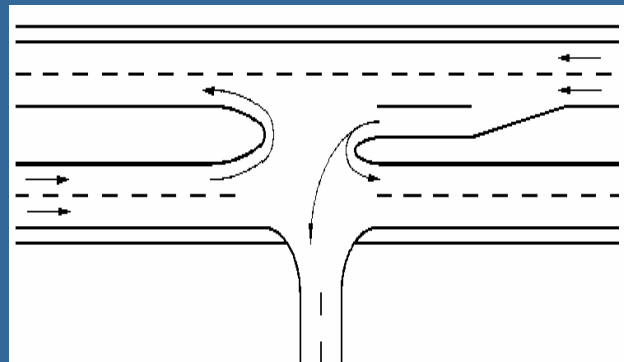
- Four-leg intersection



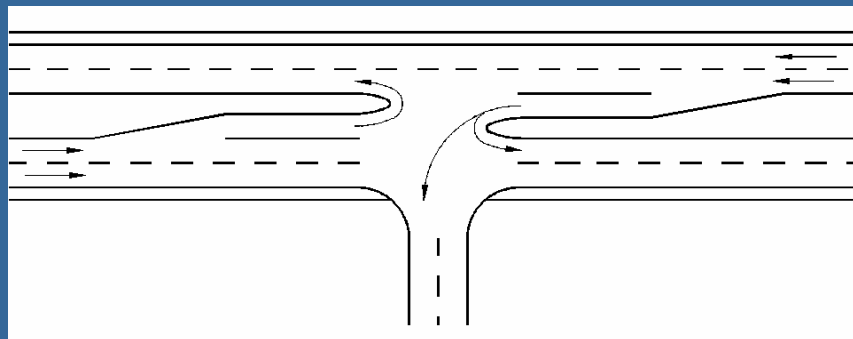


Classification of Median Openings

- Presence of left-turn lanes
 - No left-turn lane
 - One left-turn lane



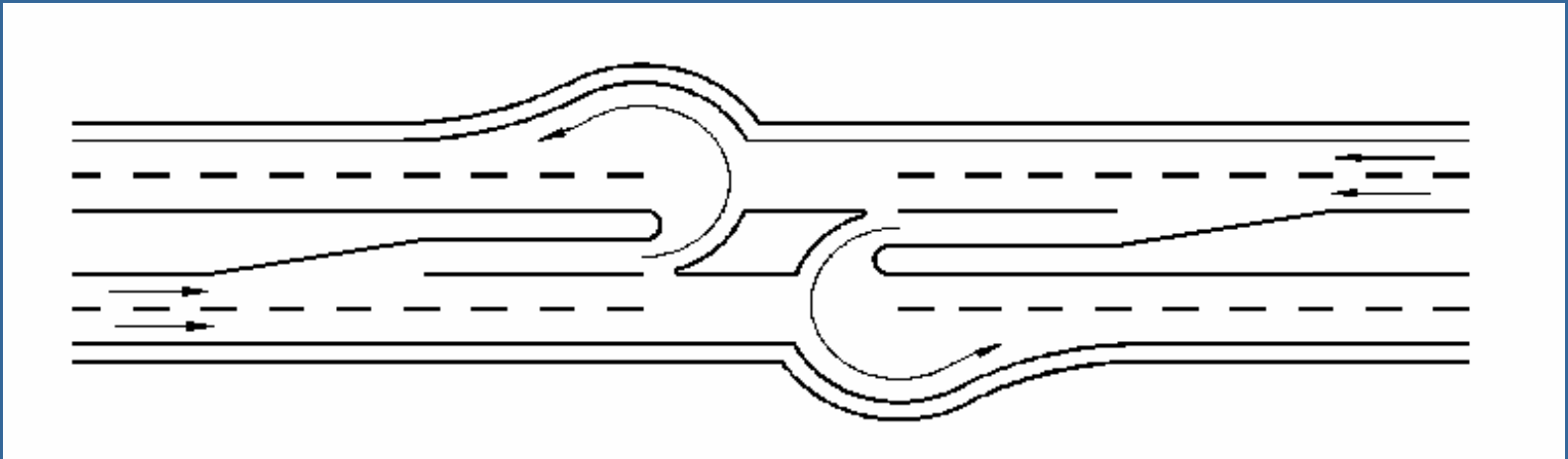
- Two left-turn lanes





Classification of Median Openings

- Presence of loons





Classification of Median Openings

1. Conventional midblock median openings
 - Type 1a—Without left-turn lanes
 - Type 1b—With left-turn lanes
 - Type 1c—With left-turn lanes and loons
2. Directional midblock median openings
 - Type 2a—Without left-turn lanes
 - Type 2b—With left-turn lanes
 - Type 2c—With left-turn lanes and loons
3. Conventional median openings at three-leg intersections
 - Type 3a—Without left-turn lanes
 - Type 3b—With one left-turn lane
 - Type 3c—With two left-turn lanes
 - Type 3d—With two left-turn lanes and loons



Classification of Median Openings

4. Directional median openings at three-leg intersections
 - Type 4a—From major road onto cross street
 - Type 4b—From cross street onto major road
5. Conventional median opening at four-leg intersections
 - Type 5a—Without left-turn lanes
 - Type 5b—With left-turn lanes
6. Directional median openings at four-leg intersections
 - Type 6a—From major road onto cross street



Midwest Research Institute

solutions through science and technology

Data Collection and Analysis



Midwest Research Institute

solutions through science and technology

Data Collection

- Colorado
- Georgia (Gwinnett County)
- Kansas
- Michigan
- Missouri
- New Jersey
- New York



Data Collection

- Database included 62 arterial corridors
- Average corridor length of 5.5 mi
- Total of 806 unsignalized median openings



Number of Median Openings by Type

Median opening type		Number of median openings
Midblock	1a	40
	1b	22
	1c	6
	2a	1
	2b	149
	2c	17
Three-leg	3a	102
	3b	91
	3c	78
	3d	9
	4a	24
	4b	0
Four-leg	5a	94
	5b	159



Data Collection

- Posted speed limit
 - ≤ 50 mph (43 percent)
 - ≥ 55 mph (57 percent)
- Majority of arterials were four-lane
- Majority of median openings had paved shoulders
- U-turn potential
 - Low (56 percent)
 - High (44 percent)



Data Collection

- Median type
 - Raised (62 percent)
 - Depressed (38 percent)
- Median width was balanced between:
 - 20 ft or less
 - 20 to 40 ft
 - Greater than 40 ft



Data Collection

- Three data collection activities
 - Field observational studies
 - Accident studies
 - *Analysis of traffic conflicts and driver behavior*



Field Observational Studies

- Conducted at four corridors in each of the following five geographic regions:
 - West (Colorado)
 - Midwest (Kansas/Missouri)
 - North (Michigan)
 - South (Georgia)
 - Northeast (New Jersey/New York)



Field Observational Studies

- One median opening per corridor selected for videotaping
- 6 hours of videotaping per site
 - Evening peak period and two off-peak periods
- Purpose:
 - Obtain turning movement volumes
 - Note traffic conflicts and undesirable driving behavior
- Short 15- to 30-min turning movement counts performed at other median openings in each corridor



Midwest Research Institute
solutions through science and technology

Field Observational Studies





Accident Studies

- Over 7,700 median-opening-related accidents at 668 median openings
 - 1.1 percent were identified as involving U-turns
 - 16.8 percent were left-turn related
 - 17.8 percent U-turn-plus-left-turn accidents



Midwest Research Institute

solutions through science and technology

Key Findings



Median Opening Accident Frequency ***Urban Arterial Corridors***

- U-turn and left-turn accidents at unsignalized median openings are infrequent
- U-turn-plus-left-turn accidents per median opening per year:
 - Urban arterial corridors: 0.41
 - Rural arterial corridors: 0.20



Median Opening Accident Rate ***Urban Arterial Corridors***

- Median openings at midblock locations substantially lower than for three- and four-leg intersections
- Median openings at three-leg intersections:
 - Directional about 48 percent lower than conventional
- Median openings at four-leg intersections:
 - Directional about 15 percent lower than conventional
- No specific problems related to loons were noted



Applications for Access Management

- U-turn maneuvers can be accommodated at median openings...safely
- When evaluating the safety performance of unsignalized median openings, highway agencies should take into account both U-turn and left-turn maneuvers



Applications for Access Management

- Where directional median openings are considered as alternatives to conventional median openings, two or more directional median openings are normally required to serve the same traffic movements as one conventional median opening
- At three-leg intersections:
 - Directional median openings, combined with a directional midblock median opening, should be considered as a supplement or an alternative to conventional median openings
- At four-leg intersections:
 - Directional median openings, combined with two directional midblock median openings, should be considered as a supplement or an alternative to conventional median openings



Applications for Access Management

- Loons can provide additional space to facilitate the larger turning path of large vehicles along narrow cross sections